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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

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01
AERONAUTICS

19970001320 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

Transactions of Nanjing University of Aeronautics and Astronautics, Volume 11

Zhang, Azhou, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Guo, Rongwei, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Yang, Zuosheng, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Zhu, Zhaodao, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Sun, Pingfan, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Xiong, Chunru, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Yao, Qiong, Editor, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Transactions of Nanjing University of Aeronautics and Astronautics; Dec. 1994; ISSN 1005-1129; Volume 11, No. 2; 239p; In English; Also announced as 19970001321 through 19970001334; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This issue contains summaries of research on the active control of wall-jet flows and the entropy characteristics of magnetic refrigerants and theoretical. In addition, articles are presented on the following topics: smart composite structures; fuselage structure optimization; diffusion bonding of titanium alloy under superplastic conditions; a prediction of the vortex-ring state boundary based on model tests; optimal design and aerodynamic calculation of the wing configuration on a civil aircraft; a method to judge the enhancement of heat transfer in the trailing edge of turbine blades; electronic control of turbine power units; integrated optics microdisplacement sensor; computer simulation of a direct torque control system; error analysis for a differential quadrature method; a concise m-metric least square formula for polynomial analogy; and a data model for a multimedia database system based on an NF(sup 2) data model.

Derived from text

Aerospace Engineering; Research and Development; Aircraft Design

19970002881 Instytut Lotnictwa, Warsaw, Poland

Transactions of the Institute of Aviation Scientific Quarterly, Number 145 ***PRACE: Instytutu Lotnictwa***

1996; ISSN 0509-6669; 200p; In Polish; 4th; Aviation Aerodynamics Symposium; Also announced as 19970002882 through 19970002894; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

This issue contains papers from: (1) The Fourth Aerodynamics Symposium, and (2) The All Polish Computation Fluid Dynamics Seminar. The first section contains papers dealing with: 30 years of investigations at the Institute of Aviation trisonic wind tunnel; Calculations of stability derivatives of aircraft using a panel method; A method for calculating lateral stability derivatives including flow separation on wing sharp edges; the simulation of an aircraft passing through a region of atmospheric disturbances using low order panel methods; the determination of sailplane loading caused by thermal gust using panel methods; numerical simulation of spatial motion dynamics for a helicopter with autopilot; analysis of the deformation of bottom surfaces of the airfoil section of the U.L. Hang Glider; a parabolic theory of stability; and the determination of separation locus of a boundary layer in a ring diffuser of a combustion turbine. Section two contains papers on: boundary elements in fluid mechanics; modeling of flow with interaction of a stationary vortex on the base of a panel; A theory and algorithm for determining flow round a three-axial ellipsoid; and the application of a boundary method of integral equation for determining space and flat flow of a perfect liquid.

Derived from text

Airfoil Profiles; Boundary Layer Separation; Computational Fluid Dynamics; Fluid Mechanics; Panel Method (Fluid Dynamics); Stability Derivatives; Trisonic Wind Tunnels; Separated Flow

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19970001326 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Dept. of Aircraft Engineering, Jiangsu, China
A Prediction of the Vortex-Ring State Boundary Based on Model Tests
Xin, Hong, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Gao, Zheng, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Transactions of Nanjing University of Aeronautics and Astronautics; Dec. 1994; Volume 11, No. 2, pp. 159-164; In English; Also announced as 19970001320; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

To understand the vortex-ring state and to develop an approach for predicting its boundary, a series of model rotor tests of vertical and oblique descent were conducted on a newly built apparatus - the whirling beam. The test results showed some unsteady aerodynamic behavior of the model rotor operating in the vortex-ring state. A very irregular variation of the rotor torque at a low rate-of-descent was observed for the first time. We considered it to be the start of the 'power settling' and determined the critical descent velocity according to this observation. A previous criterion for the vortex-ring state was modified to provide a semi-empirical method for predicting the entire vortex-ring state boundary. The computed boundary shows a good correlation with the model test results and flight experiences.
Author
Unsteady Aerodynamics; Vortex Rings; Rotary Wings; Helicopter Control; Descent

19970001327 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Dept. of Aerodynamics, Jiangsu, China
Optimal Design and Aerodynamic Calculation of Wing Configuration of Civil Aircraft
Wang, Liangyi, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Transactions of Nanjing University of Aeronautics and Astronautics; Dec. 1994; Volume 11, No. 2, pp. 165-169; In English; Also announced as 19970001320; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

An effective method for the optimal design of a wing configuration is provided. The sequential unconstrained minimization technique (SUMT) is a good technique for solving nonlinear programming. The application of a penalty in optimal design of a wing configuration has been solved well. The present method of the aerodynamic calculation is the combination of both the nonlinear panel method and the suction analogy method of vortex lift spanwise distribution on a large swept wing tip. The calculation results are in good agreement with experimental data. According to the computation and the experiment, the mechanism of increased lift and reduced drag about the sheared wing tip has been analyzed, and some opinions of interest are proposed.
Author
Aerodynamic Configurations; Swept Wings; Panel Method (Fluid Dynamics); Aerodynamic Characteristics; Optimization

19970001363 NYMA, Inc., Brook Park, OH USA
Screech Tones from Rectangular Jets with Spanwise Oblique Shock-Cell Structures ***Final Report***
Raman, Ganesh, NYMA, Inc., USA; Sep. 1996; 34p; In English; 34th; Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 505-62-52
Report No.(s): NASA-CR-198417; E-9984; NAS 1.26:198417; AIAA Paper 96-0643; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Understanding screech is especially important for the design of advanced aircraft because screech can cause sonic fatigue failure of aircraft structures. Although the connection between shock-cell spacing and screech frequency is well understood, the relation between non-uniformities in the shock-cell structures and the resulting amplitude, mode, and steadiness of screech have remained unexplored. This paper addresses the above issues by intentionally producing spanwise (larger nozzle dimension) variations in the shock-cell structures and studying the resulting spanwise screech mode. The spanwise oblique shock-cell structures were produced using imperfectly expanded convergent-divergent rectangular nozzles (aspect ratio = 5) with nonuniform exit geometries. Three geometries were studied: (a) a nozzle with a spanwise uniform edge, (b) a nozzle with a spanwise oblique (single bevelled) edge, and (c) a nozzle that had two spanwise oblique (double bevelled) cuts to form an arrowhead-shaped nozzle. For all nozzles considered, the screech mode was antisymmetric in the transverse (smaller nozzle dimension) direction allowing focus on changes in the spanwise direction. Three types of spanwise modes were observed: symmetric (1), antisymmetric (2), and oblique (3). The following significant results emerged: (1) for all cases the screech mode corresponds with the spanwise shock-cell structure, (2) when multiple screech modes are present, the technique presented here makes it possible to distinguish between coexisting and mutually exclusive modes, (3) the strength of shocks 3 and 4 influences the screech source amplitude and deter-

mines whether screech is unsteady. The results presented here offer hope for a better understanding of screech and for tailoring shock-containing jets to minimize fatigue failure of aircraft components.
Author
Oblique Shock Waves; Acoustic Fatigue; Aircraft Design; Aircraft Structures; Convergent-Divergent Nozzles

19970001416 Lockheed Martin Engineering and Sciences Co., Langley Program Office, Hampton, VA USA
Computational Study of a McDonnell Douglas Single-Stage-to-Orbit Vehicle Concept for Aerodynamic Analysis
Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; Sep. 1996; 24p; In English
Contract(s)/Grant(s): NAS1-19000; RTOP 242-20-80-02
Report No.(s): NASA-CR-201606; NAS 1.26:201606; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents the results of a computational flow analysis of the McDonnell Douglas single-stage-to-orbit vehicle concept designated as the 24U. This study was made to determine the aerodynamic characteristics of the vehicle with and without body flaps over an angle of attack range of 20-40 deg. Computations were made at a flight Mach number of 20 at 200,000 ft. altitude with equilibrium air, and a Mach number of 6 with CF4 gas. The software package FELISA (Finite Element Langley imperial College Sawansea Ames) was used for all the computations. The FELISA software consists of unstructured surface and volume grid generators, and inviscid flow solvers with (1) perfect gas option for subsonic, transonic, and low supersonic speeds, and (2) perfect gas, equilibrium air, and CF4 options for hypersonic speeds. The hypersonic flow solvers with equilibrium air and CF4 options were used in the present studies. Results are compared with other computational results and hypersonic CF4 tunnel test data.
Author
Unstructured Grids (Mathematics); Single Stage to Orbit Vehicles; Inviscid Flow; Hypersonic Speed; Hypersonic Flow; Finite Element Method; Computational Grids; Applications Programs (Computers); Aerodynamic Characteristics

19970001428 Stanford Univ., Dept. of Mechanical Engineering., CA USA
The Physics of Turbulence in the Boundary Layer ***Final Report, 25 Apr. 1994 - 24 Oct. 1995***
Kline, Stephen, Stanford Univ., USA; Cantwell, Brian, Stanford Univ., USA; Oct. 24, 1995; 31p; In English
Contract(s)/Grant(s): NAG1-1610
Report No.(s): NASA-CR-202437; NAS 1.26:202437; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The geometry of the velocity field in a numerically simulated incompressible turbulent boundary layer over a flat plate at Re theta=670 has been studied using the invariants of the velocity gradient tensor. These invariants are computed at every grid point in the flow and used to form the discriminant. of primary interest are those regions in the flow where the discriminant is positive; regions where, according to the characteristic equation, the eigenvalues of the velocity gradient tensor are complex. An observer moving with a frame of reference which is attached to a fluid particle lying within such a region would see a local flow pattern of the type stable-focus-stretching or unstable-focus-compressing. When the flow is visualized this way, continuous, connected, large-scale structures are revealed that extend from the point just below the buffer layer out to the beginning of the wake region. These structures are aligned with the mean shear close to the wall and arch in the cross-stream direction away from the wall. In some cases the structures observed are very similar to to the hairpin eddy vision of boundary layer structure proposed by Theodorsen. That the structure of the flow is revealed more effectively by the discriminant rather than by the vorticity is important and adds support to recent observations of the discriminant in a channel flow simulation. of particular importance is the fact that the procedure does not require the use of an arbitrary threshold in the discriminant. Further analysis using computer flow visualization shows a high degree of spatial correlation between regions of positive discriminant, extreme negative pressure fluctuations and large instantaneous values of Reynolds shear stress.
Author
Turbulent Boundary Layer; Turbulent Flow; Flow Visualization; Incompressible Boundary Layer; Wall Flow; Channel Flow; Flow Distribution; Shear Stress; Reynolds Stress; Laminar Flow

19970001592 Defense Intelligence Agency, Missile and Space Intelligence Center, Redstone Arsenal, AL USA
Techniques for Determining Missile Roll Parameters from a Wind Tunnel
Wincey, Ronald T., Defense Intelligence Agency, USA; Oct. 1995; 34p; In English
Report No.(s): AD-A307209; MSC2-TM-95-001; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

A collection of the most prominent wind tunnel test techniques for determining missile aerodynamic roll parameters is presented. Both free-spin, and constrained-spin techniques are presented along with each techniques' advantages and disadvantages.

Special consideration is given to showing how the model bearing friction can be automatically cancelled from the roll balance measurement by an internal electric spin-motor. This technique alleviates the need for special bearing-friction tare measurements.
DTIC
Wind Tunnel Tests; Missiles; Roll; Damping

19970001611 Department of the Navy, Washington, DC USA
Articulated Fin
Nedderman, William H., Jr, Inventor, Department of the Navy, USA; Jun. 03, 1996; 15p; In English
Patent Info.: US-Patent-Appl-SN-668605
Report No.(s): AD-D018073; No Copyright; Avail: Issuing Activity (Department of the Navy, Washington, D. C.), Microfiche

An articulated fin of the present invention includes a nose section, a tail section, an upper flexible control surface, and a lower flexible control surface. The upper and lower flexible control surfaces each span from the tail section to the nose section. The fin further includes a gear assembly for applying compressive and tensile forces on the upper and lower flexible control surfaces. The gear assembly bends the tail section upwardly upon applying a tensile force on the upper flexible control surface and a compression force on the lower flexible control surface, and bends the tail section downwardly upon applying a compression force on the upper flexible control surface and a tensile force on the lower flexible control surface.
DTIC
Hydrodynamics; Aerodynamic Characteristics; Compressibility; Control Surfaces; Fins

19970001675 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA
Experimental Investigation of the Flow Field in a Transonic, Axial Flow Compressor with Respect to the Development of Blockage and Loss
Suder, Kenneth L., National Aeronautics and Space Administration. Lewis Research Center, USA; Oct. 1996; 268p; In English
Contract(s)/Grant(s): RTOP 505-62-52
Report No.(s): NASA-TM-107310; NAS 1.15:107310; E-10403; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

A detailed experimental investigation to understand and quantify the development of loss and blockage in the flow field of a transonic, axial flow compressor rotor has been undertaken. Detailed laser anemometer measurements were acquired upstream, within, and downstream of a transonic, axial compressor rotor operating at design and off-design conditions. The rotor was operated at 100%, 85%, 80%, and 60% of design speed which provided inlet relative Mach numbers at the blade tip of 1.48, 1.26, 1.18, and 0.89 respectively. At design speed the blockage is evaluated ahead of the rotor passage shock, downstream of the rotor passage shock, and near the trailing edge of the blade row. The blockage is evaluated in the core flow area as well as in the CASIng endwall region. Similarly at pm speed conditions for the cases of (1) where the rotor passage shock is much weaker than that at design speed and (2) where there is no rotor passage shock, the blockage and loss are evaluated and compared to the results at design speed. Specifically, the impact of the rotor passage shock on the blockage and loss development, pertaining to both the shock/boundary layer interactions and the shock/tip clearance flow interactions, is discussed. In addition, the blockage evaluated from the experimental data is compared to (1) an existing correlation of blockage development which was based on computational results, and (2) computational results on a limited basis. The results indicate that for this rotor the blockage in the endwall region is 2-3 times that of the core flow region and the blockage in the core flow region more than doubles when the shock strength is sufficient to separate the suction surface boundary layer. The distribution of losses in the care flow region indicate that the total loss is primarily comprised of the shock loss when the shock strength is not sufficient to separate the suction surface boundary layer. However, when the shock strength is sufficient to separate the suction surface boundary layer, the profile loss is comparable to the shock loss and can exceed the shock loss.
Author
Flow Distribution; Transonic Flow; Turbocompressors; Mach Number; Transonic Compressors; Shock Wave Interaction

19970001734 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Static Internal Performance of a Two-Dimensional Convergent-Divergent Nozzle with External Shelf
Lamb, Milton, National Aeronautics and Space Administration. Langley Research Center, USA; Taylor, John G., National Aeronautics and Space Administration. Langley Research Center, USA; Frassinelli, Mark C., Wright Research Development Center, USA; Sep 1996; 110p; In English
Contract(s)/Grant(s): RTOP 505-59-70-04
Report No.(s): NASA-TM-4719; NAS 1.15:4719; L-17478; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

An investigation was conducted in the static test facility of the Langley 16-Foot Transonic Tunnel to determine the internal performance of a two-dimensional convergent-divergent nozzle. The nozzle design was tested with dry and afterburning throat

areas, which represent different power settings and three expansion ratios. For each of these configurations, three trailing-edge geometries were tested. The baseline geometry had a straight trailing edge. Two different shaping techniques were applied to the baseline nozzle design to reduce radar observables: the scarfed design and the sawtooth design. A flat plate extended downstream of the lower divergent flap trailing edge parallel to the model centerline to form a shelf-like expansion surface. This shelf was designed to shield the plume from ground observation (infrared radiation (IR) signature suppression). The shelf represents the part of the aircraft structure that might be present in an installed configuration. These configurations were tested at nozzle pressure ratios from 2.0 to 12.0.
Author
Convergent-Divergent Nozzles; Pressure Ratio; Pressure Distribution; Throats; Static Tests; Plumes; Nozzle Design; Afterburning; Aircraft Structures; Two Dimensional Flow; Two Dimensional Models

19970001772 Analytical Methods, Inc., Redmond, WA USA
Development of Three-Dimensional Flow Code Package to Predict Performance and Stability of Aircraft with Leading Edge Ice Contamination *Final Report*
Strash, D. J., Analytical Methods, Inc., USA; Summa, J. M., Analytical Methods, Inc., USA; Sep. 1996; 100p; In English
Contract(s)/Grant(s): NAS3-26310; RTOP 505-68-10
Report No.(s): NASA-CR-198519; E-10399; NAS 1.26:198519; AMI-9408; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

In the work reported herein, a simplified, uncoupled, zonal procedure is utilized to assess the capability of numerically simulating icing effects on a Boeing 727-200 aircraft. The computational approach combines potential flow plus boundary layer simulations by VSAERO for the un-iced aircraft forces and moments with Navier-Stokes simulations by NPARC for the incremental forces and moments due to iced components. These are compared with wind tunnel force and moment data, supplied by the Boeing Company, examining longitudinal flight characteristics. Grid refinement improved the local flow features over previously reported work with no appreciable difference in the incremental ice effect. The computed lift curve slope with and without empennage ice matches the experimental value to within 1%, and the zero lift angle agrees to within 0.2 of a degree. The computed slope of the un-iced and iced aircraft longitudinal stability curve is within about 2% of the test data. This work demonstrates the feasibility of a zonal method for the icing analysis of complete aircraft or isolated components within the linear angle of attack range. In fact, this zonal technique has allowed for the viscous analysis of a complete aircraft with ice which is currently not otherwise considered tractable.
Author
Aircraft Icing; Grid Generation (Mathematics); Boeing 727 Aircraft; Navier-Stokes Equation; Computational Fluid Dynamics; Three Dimensional Flow; Longitudinal Stability; Panel Method (Fluid Dynamics)

19970001786 Polytechnic Univ., Aerospace Enigneering Dept., Brooklyn, NY USA
Measurements of Supersonic Wing Tip Vortices
Smart, Michael K., Polytechnic Univ., USA; Kalkhoran, Iraj M., Polytechnic Univ., USA; Benston, James, Polytechnic Univ., USA; 1994; 14p; In English; 18th; Aerospace Ground Testing, 20-23 Jun. 1994, Colorado Springs, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAG3-1378; F49620-93-1-0009
Report No.(s): NASA-CR-202591; NAS 1.26:202591; AIAA Paper 94-2576; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental survey of supersonic wing tip vortices has been conducted at Mach 2.5 using small performed 2.25 chords down-stream of a semi-span rectangular wing at angle of attack of 5 and 10 degrees. The main objective of the experiments was to determine the Mach number, flow angularity and total pressure distribution in the core region of supersonic wing tip vortices. A secondary aim was to demonstrate the feasibility of using cone probes calibrated with a numerical flow solver to measure flow characteristics at supersonic speeds. Results showed that the numerically generated calibration curves can be used for 4-hole cone probes, but were not sufficiently accurate for conventional 5-hole probes due to nose bluntness effects. Combination of 4-hole cone probe measurements with independent pitot pressure measurements indicated a significant Mach number and total pressure deficit in the core regions of supersonic wing tip vortices, combined with an asymmetric 'Burger like' swirl distribution.
Author
Wing Tip Vortices; Flow Characteristics; Pressure Distribution; Pressure Measurement; Rectangular Wings; Supersonic Speed

19970001799 National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA USA
Effect of Actuated Forebody Strakes on the Forebody Aerodynamics of the NASA F-18 HARV
Fisher, David F., National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, USA; Murri, Daniel G., National Aeronautics and Space Administration. Langley Research Center, USA; Lanser, Wendy R., National Aeronautics and Space Administration. Ames Research Center, USA; Oct. 1996; 36p; In English
Contract(s)/Grant(s): RTOP 505-68-30
Report No.(s): NASA-TM-4774; H-2136; NAS 1.15:4774; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Extensive pressure measurements and off-surface flow visualization were obtained on the forebody and strakes of the NASA F-18 High Alpha Research Vehicle (HARV) equipped with actuated forebody strakes. Forebody yawing moments were obtained by integrating the circumferential pressures on the forebody and strakes. Results show that large yawing moments can be generated with forebody strakes. At angles of attack greater than 40 deg., deflecting one strake at a time resulted in a forebody yawing moment control reversal for small strake deflection angles. At alpha = 40 deg. and 50 deg., deflecting the strakes differentially about a 20 deg. symmetric strake deployment eliminated the control reversal and produced a near linear variation of forebody yawing moment with differential strake deflection. At alpha = 50 deg. and for 0 deg. and 20 deg. symmetric strake deployments, a larger forebody yawing moment was generated by the forward fuselage (between the radome and the apex of the leading-edge extensions), than on the radome where the actuated forebody strakes were located. Cutouts on the flight vehicle strakes that were not on the wind tunnel models are believed to be responsible for deficits in the suction peaks on the flight radome pressure distributions and differences in the forebody yawing moments.
Author
Angle of Attack; F-18 Aircraft; Aerodynamics; Leading Edges; Strakes; Yawing Moments; Pressure Distribution; Flow Visualization

19970001807 NASA Langley Research Center, Hampton, VA USA
Comparison of Turbulence Models for Nozzle-Afterbody Flows with Propulsive Jets
Compton, William B., III, NASA Langley Research Center, USA; Sep. 1996; 122p; In English
Contract(s)/Grant(s): RTOP 505-59-70-04
Report No.(s): NASA-TP-3592; NAS 1.60:3592; L-17506; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A numerical investigation was conducted to assess the accuracy of two turbulence models when computing non-axisymmetric nozzle-afterbody flows with propulsive jets. Navier-Stokes solutions were obtained for a Convergent-divergent non-axisymmetric nozzle-afterbody and its associated jet exhaust plume at free-stream Mach numbers of 0.600 and 0.938 at an angle of attack of 0 deg. The Reynolds number based on model length was approximately 20 x 10(exp 6). Turbulent dissipation was modeled by the algebraic Baldwin-Lomax turbulence model with the Degani-Schiff modification and by the standard Jones-Launder kappa-epsilon turbulence model. At flow conditions without strong shocks and with little or no separation, both turbulence models predicted the pressures on the surfaces of the nozzle very well. When strong shocks and massive separation existed, both turbulence models were unable to predict the flow accurately. Mixing of the jet exhaust plume and the external flow was underpredicted. The differences in drag coefficients for the two turbulence models illustrate that substantial development is still required for computing very complex flows before nozzle performance can be predicted accurately for all external flow conditions.
Author
Convergent-Divergent Nozzles; Navier-Stokes Equation; Nozzle Flow; Turbulence Models; K-Epsilon Turbulence Model; Jet Exhaust; Free Flow; Exhaust Gases; Computational Fluid Dynamics; Axisymmetric Flow; Angle of Attack; Aerodynamic Coefficients

19970001814 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA USA
Navier-Stokes Calculations for a Highly-Twisted Rotor Near Stall
Yamauchi, Gloria K., National Aeronautics and Space Administration. Ames Research Center, USA; Johnson, Wayne R., Johnson Aeronautics, USA; 1994; 26p; In English; Aeromechanics Specialists, 19-21 Jan. 1994, San Fransisco, CA, USA; Sponsored by American Helicopter Society, Inc., USA
Report No.(s): NASA-TM-111741; NAS 1.15:111741; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

The viscous flow field near the surface of a hovering rotor blade was studied for blade twist distributions typical of a till rotor blade and a conventional helicopter rotor blade. Three blade geometries were studied, including a tilt rotor blade twist distribution (baseline), conventional helicopter rotor blade twist distribution, and the baseline twist distribution with 2 deg of precone. The results give insight into the delayed stall phenomenon often observed for highly twisted rotors. Calculations were performed for a high thrust condition near stall using the thin-layer Navier-Stokes CFD code TURNS. Effects of built-in twist on section force

coefficients, skin friction, velocities, surface pressures, and boundary layer shape factor are discussed. Although the rotor thrust coefficient was nominally the same for the cases using the two twist distributions, large differences were found in the section in-plane and normal force coefficients. These preliminary results imply that the blade outboard region, rather than the inboard region, provides the majority of the performance advantage of the baseline case over the low twist case. Skin friction, velocities near the blade, and surface pressures for the two twist distributions reveal significant differences in the blade outboard region.
Author
Navier-Stokes Equation; Rotary Wings; Rotors; Tilt Rotor Aircraft; Viscous Flow; Flow Distribution

19970001863 NASA Langley Research Center, Hampton,VA USA
Multiaxis Thrust-Vectoring Characteristics of a Model Representative of the F-18 High-Alpha Research Vehicle at Angles of Attack From 0 deg to 70 deg
Asbury, Scott C., NASA Langley Research Center, USA; Capone, Francis J., NASA Langley Research Center, USA; Dec. 1995; 180p; In English
Contract(s)/Grant(s): RTOP 505-59-30-04
Report No.(s): NASA-TP-3531; L-17441; NAS 1.26:3531; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

An investigation was conducted in the Langley 16-Foot Transonic Tunnel to determine the multiaxis thrust-vectoring characteristics of the F-18 High-Alpha Research Vehicle (HARV). A wingtip supported, partially metric, 0.10-scale jet-effects model of an F-18 prototype aircraft was modified with hardware to simulate the thrust-vectoring control system of the HARV. Testing was conducted at free-stream Mach numbers ranging from 0.30 to 0.70, at angles of attack from O' to 70', and at nozzle pressure ratios from 1.0 to approximately 5.0. Results indicate that the thrust-vectoring control system of the HARV can successfully generate multiaxis thrust-vectoring forces and moments. During vectoring, resultant thrust vector angles were always less than the corresponding geometric vane deflection angle and were accompanied by large thrust losses. Significant external flow effects that were dependent on Mach number and angle of attack were noted during vectoring operation. Comparisons of the aerodynamic and propulsive control capabilities of the HARV configuration indicate that substantial gains in controllability are provided by the multiaxis thrust-vectoring control system.
Author
F-18 Aircraft; Thrust Vector Control; Research Vehicles; Nozzles

19970001869 Polhamus (Edward C.), Newport News, VA USA
A Survey of Reynolds Number and Wing Geometry Effects on Lift Characteristics in the Low Speed Stall Region
Polhamus, Edward C., Polhamus (Edward C.), USA; Jun. 1996; 98p; In English
Contract(s)/Grant(s): PO L21824C; RTOP 505-59-10-43
Report No.(s): NASA-CR-4745; NAS 1.26:4745; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This paper presents a survey of the effects of Reynolds number on the low- speed lift characteristics of wings encountering separated flows at their leading and side edges, with emphasis on the region near the stall. The influence of leading-edge profile and Reynolds number on the stall characteristics of two- dimensional airfoils are reviewed first to provide a basis for evaluating three- dimensional effects associated with various wing planforms. This is followed by examples of the effects of Reynolds number and geometry on the lift characteristics near the stall for a series of three-dimensional wings typical of those suitable for high-speed aircraft and missiles. Included are examples of the effects of wing geometry on the onset and spanwise progression of turbulent reseparation near the leading edge and illustrations of the degree to which simplified theoretical approaches can be useful in defining the influence of the various geometric parameters. Also illustrated is the manner in which the Reynolds number and wing geometry parameters influence whether the turbulent reseparation near the leading edge results in a sudden loss of lift, as in the two-dimensional case, or the formation of a leading-edge vortex with Rs increase in lift followed by a gentle stall as in the highly swept wing case. Particular emphasis is placed on the strong influence of 'induced camber' on the development of turbulent reseparation. R is believed that the examples selected for this report may be useful in evaluating viscous flow solutions by the new computational methods based on the Navier-Stokes equations as well as defining fruitful research areas for the high-Reynolds-number wind tunnels.
Author
Aerodynamic Stalling; Low Speed; Leading Edges; Swept Wings; Wing Planforms

19970002888 Instytut Lotnictwa, Warsaw, Poland
An Analysis of Deformation of Bottom Surface of the Aerofoil Section of U. L. Hangglider ***Analiza odksztalcen elastycznej dolnej powloki profilu miekkoplata***
Wolf, jerzy, Instytut Lotnictwa, Poland; Stalewski, Wienczyslaw, Instytut Lotnictwa, Poland; Transactions of the Institute of Avi-

ation Scientific Quarterly; 1996; Volume 45, pp. 97-114; In Polish; Also announced as 19970002881; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A theoretical foundation for the description of aerofoil section deformation under the influence of aerodynamic loading is presented. A new type of physical model of U.L Hang Glider is presented, , characterized by a stiff upper surface and stiff nose part of the aerofoil section and deformable lower part of the section, which may be caused by overpressure of sucking off o fthe shell by variable inside pressure. The analysis is limited to a two dimensional case, i.e., for the aerofoil section of U.L. hang gliders of infinite aspect ratio. The analysis is related to the deformation of a bottom elastic profile shell at a given pressure loading. Getting over the force balance, which acts on an arbitrary segment of the deformed shell problem is described by a set of differential equations at given boundary conditions. Reducing the equation set to a non-dimensional state, an algorithm is presented. In order to verify the depicted model, computer calculation tests are preformed. The calculation results are presented in a graphical state. Results show that is is practically possible to form an automatic variable camber aerofoil of improved aerodynamic properties in relation to non-deformable aerofoil sections.

Author

Aerodynamic Loads; Elastic Shells; Hang Gliders; Differential Equations; Airfoil Profiles; Aspect Ratio

19970002912 Defence Science and Technology Organisation, Air Operations Div., Melbourne, Australia

Low-Speed Wind-Tunnel Tests of a Full-Scale Mk82 Store Model

Quick, Howard A., Defence Science and Technology Organisation, Australia; Aug. 1996; 91p; In English

Report No.(s): DSTO-TR-0389; AR-009-785; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victioria 3001, Australia), Hardcopy, Microfiche

Low-speed Wind-tunnel tests of a full-scale Mk82 store model have been conducted for an extensive range of store configurations and model attitudes at close to flight Reynolds number. Tests included 'fully-armed' store configurations representative of stores in RAAF F-111C and F/A-18 operational service, as well as investigations into incremental effects of individual components.

Author

Wind Tunnel Tests; Low Speed; Aircraft Models; Explosive Devices; Aerodynamic Characteristics; Data Acquisition

19970002919 Santa Clara Univ., CA USA

Development of Advanced Methods of Structural and Trajectory Analysis for Transport Aircraft ***Annual Report, 1 Oct. 1995 - 30 Sep. 1996***

Ardema, Mark D., Santa Clara Univ., USA; Sep. 30, 1996; 94p; In English

Contract(s)/Grant(s): NCC2-5167

Report No.(s): NASA-CR-202510; NAS 1.26:202510; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

In this report the author describes: (1) development of advanced methods of structural weight estimation, and (2) development of advanced methods of flight path optimization. A method of estimating the load-bearing fuselage weight and wing weight of transport aircraft based on fundamental structural principles has been developed. This method of weight estimation represents a compromise between the rapid assessment of component weight using empirical methods based on actual weights of existing aircraft and detailed, but time-consuming, analysis using the finite element method. The method was applied to eight existing subsonic transports for validation and correlation. Integration of the resulting computer program, PDCYL, has been made into the weights-calculating module of the AirCraft SYNThesis (ACSYNT) computer program. ACSYNT bas traditionally used only empirical weight estimation methods; PDCYL adds to ACSYNT a rapid, accurate means of assessing the fuselage and wing weights of unconventional aircraft. PDCYL also allows flexibility in the choice of structural concept, as well as a direct means of determining the impact of advanced materials on structural weight.

Derived from text

Finite Element Method; Computer Programs; Structural Weight; Structural Design Criteria

19970003008 Notre Dame Univ., Dept. of Aerospace and Mechanical Engineering, IN USA

Key Topics for High-Lift Research: A Joint Wind Tunnel/Flight Test Approach ***Progress Report, 1 May 1995 - 30 Sep. 1996***

Fisher, David, NASA Dryden Flight Research Center, USA; Thomas, Flint O., Notre Dame Univ., USA; Nelson, Robert C., Notre Dame Univ., USA; Sep. 30, 1996; 30p; In English

Contract(s)/Grant(s): NCC2-5128

Report No.(s): NASA-CR-202525; NAS 1.26:202525; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Future high-lift systems must achieve improved aerodynamic performance with simpler designs that involve fewer elements and reduced maintenance costs. To expeditiously achieve this, reliable CFD design tools are required. The development of useful

CFD-based design tools for high lift systems requires increased attention to unresolved flow physics issues. The complex flow field over any multi-element airfoil may be broken down into certain generic component flows which are termed high-lift building block flows. In this report a broad spectrum of key flow field physics issues relevant to the design of improved high lift systems are considered. It is demonstrated that in-flight experiments utilizing the NASA Dryden Flight Test Fixture (which is essentially an instrumented ventral fin) carried on an F-15B support aircraft can provide a novel and cost effective method by which both Reynolds and Mach number effects associated with specific high lift building block flows can be investigated. These in-flight high lift building block flow experiments are most effective when performed in conjunction with coordinated ground based wind tunnel experiments in low speed facilities. For illustrative purposes three specific examples of in-flight high lift building block flow experiments capable of yielding a high payoff are described. The report concludes with a description of a joint wind tunnel/flight test approach to high lift aerodynamics research.
Author
Flight Tests; Wind Tunnel Tests; Flow Distribution; Fins; Airfoils; Aerodynamics; F-15 Aircraft; Lift

19970003074 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Figures of Merit for Aeronautics Programs and Addition to NASA LARC Fire Station
Harper, Belinda M., Virginia Polytechnic Inst. and State Univ., USA; Technical Reports: Langley Aerospace Research Summer Scholars; 1995; Part 1, pp. 227-236; In English; Also announced as 19970003049; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This report accounts details of two research projects for the Langley Aerospace Research Summer Scholars (LARSS) program. The first project, with the Office of Mission Assurance, involved subjectively predicting the probable success of two aeronautics programs by means of a tool called a Figure of Merit. The figure of merit bases program success on the quality and reliability of the following factors: parts, complexity of research, quality programs, hazards elimination, and single point failures elimination. The second project, for the Office of Safety and Facilities Assurance, required planning, layouts, and source seeking for an addition to the fire house. Forecasted changes in facility layout necessitate this addition which will serve as housing for the fire fighters.
Author
Figure of Merit; Quality; Reliability Analysis

19970003085 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Conversion of the Aerodynamic Preliminary Analysis System (APAS) to an IBM PC Compatible Format
Kruep, John M., Virginia Polytechnic Inst. and State Univ., USA; Technical Reports: Langley Aerospace Research Summer Scholars; 1995; Part 1, pp. 379-388; In English; Also announced as 19970003049; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The conversion of the Aerodynamic Preliminary Analysis System (APAS) software from a Silicon Graphics UNIX-based platform to a DOS-based IBM PC compatible is discussed. Relevant background information is given, followed by a discussion of the steps taken to accomplish the conversion and a discussion of the type of problems encountered during the conversion. A brief comparison of aerodynamic data obtained using APAS with data from another source is also made.
Author
Aerodynamic Characteristics; Computer Programs; Failure Analysis; Stress Analysis; Structural Analysis

19970003086 College of William and Mary, Hampton, VA USA
Modeling of the Expected Lidar Return Signal for Wake Vortex Experiments
Kruschwitz, Craig A., College of William and Mary, USA; Technical Reports: Langley Aerospace Research Summer Scholars; 1995; Part 1, pp. 389-392; In English; Also announced as 19970003049; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

A computer program that models the Lidar return signal for Wake Vortex experiments conducted by the Aerosol Research Branch was written. The specifications of the program and basic theory behind the calculations are briefly discussed. Results of the research and possible future improvements on it are also discussed.
Author
Computer Programs; Optical Radar

19970003118 Washington Univ., Bellingham, WA USA
Analog Processing Assembly for the Wake Vortex Lidar Experiment
Stowe, Edwood G., Washington Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 717-724; In En-

glish; Also announced as 19970003089; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Federal Aviation Administration (FAA) and NASA have initiated a joint study in the development of reliable means of tracking, detecting, measuring, and predicting trailing wake-vortices of commercial aircraft. Being sought is an accurate model of the wake-vortex hazard, sufficient to increase airport capacity by reducing minimum safe spacings between planes. Several means of measurement are being evaluated for application to wake-vortex detection and tracking, including Doppler RADAR (Radio Detection and Ranging) systems, 2-micron Doppler LIDAR (Light Detection and Ranging) systems, and SODAR (Sound Detection and Ranging) systems. of specific interest there is the lidar system, which has demonstrated numerous valuable capabilities as a vortex sensor Aerosols entrained in the vortex flow make the wake velocity signature visible to the lidar, (the observable lidar signal is essentially a measurement of the line-of-sight velocity of the aerosols). Measurement of the occurrence of a wake vortex requires effective reception and monitoring of the beat signal which results from the frequency-offset between the transmitted pulse and the backscattered radiation. This paper discusses the mounting, analysis, troubleshooting, and possible use of an analog processing assembly designed for such an application.
Author
Vortices; Wakes; Tracking (Position); Detection; Predictions; Flow Measurement

19970003128 Illinois Univ., Champaign, IL USA
Analysis of a High-Lift Multi-Element Airfoil using a Navier-Stokes Code
Whitlock, Mark E., Illinois Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 807-816; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A thin-layer Navier-Stokes code, CFL3D, was utilized to compute the flow over a high-lift multi-element airfoil. This study was conducted to improve the prediction of high-lift flowfields using various turbulence models and improved glidding techniques. An overset Chimera grid system is used to model the three element airfoil geometry. The effects of wind tunnel wall modeling, changes to the grid density and distribution, and embedded grids are discussed. Computed pressure and lift coefficients using Spalart-Allmaras, Baldwin-Barth, and Menter's kappa-omega - Shear Stress Transport (SST) turbulence models are compared with experimental data. The ability of CFL3D to predict the effects on lift coefficient due to changes in Reynolds number changes is also discussed.
Author
Navier-Stokes Equation; K-Epsilon Turbulence Model; Turbulence Models; Boundary Layers; Airfoil Profiles

19970003129 Kansas Univ., Lawrence, KS USA
Wake Vortex Encounter Research
Wilson, Jeffrey M., Kansas Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 817-823; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration (NASA) is conducting research to improve airport capacity by reducing the separation distance between aircraft. The limiting factor in reducing separation distances and improving airport capacity is the wake vortex hazard. The ability to accurately model wake vortices and predict the outcome of a vortex encounter is critical in developing a system to safely improve airport capacity. This is the focus of the wake vortex research being done at NASA Langley Research Center (LaRC). This paper will concentrate on two topics. The first topic is the control system developed for the Boeing 737 freeflight model in support of vortex encounter tests to be conducted in the 30- by 60- foot tunnel at NASA Langley Research Center later this year. The second topic discussed is the limited degree of freedom (DOF) trajectory generation study that is being conducted to determine the relative severity of a multitude of paths through a wake vortex.
Author
Boeing 737 Aircraft; Vortices; Aircraft Wakes; Flight Hazards

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19970001565 British Columbia Univ., Vancouver, British Columbia Canada
A New Proof-of-Principle Contraband Detection System
Sredniawski, Joseph J., Northrop Grumman Corp., USA; Debiak, T., Northrop Grumman Corp., USA; Kamykowski, E., Northrop Grumman Corp., USA; Rathke, J., Northrop Grumman Corp., USA; Schmor, P., Tri-Univ. Meson Facility, Canada; Altman, A., Tri-Univ. Meson Facility, Canada; Rogers, J., Tri-Univ. Meson Facility, Canada; Boyd, J., Tri-Univ. Meson Facility, Canada;

Brondo, J., Scientific Innovations, Inc., USA; Dec. 1995; 11p; In English; ONDCP International Technology Symposium, 24 - 27 Oct. 1995, Nashua, NH, USA
Contract(s)/Grant(s): F08650-94-C-0097
Report No.(s): TRI-PP-95-93; CONF-9510221-5; DE96-013381; No Copyright; Avail: Issuing Activity (Department of Energy (DOE)), Microfiche

A new concept for a CDS has been developed under a Phase 1 ARPA funded program; it uses gamma resonance absorption (GRA) to detect certain illegal drugs that may be transported in man-portable containers. A high detection probability for heroin and cocaine is possible with a device that is also searching for explosives. Elemental detection of both N and Cl is utilized, and with tomography, a 3D density image of the elements is generated. Total density image is also developed. These two together may be used with considerable confidence in determining if heroin or cocaine is present in the interrogated containers in a small quantity (1 kg). The CDS employs a high current ((ge)10 mA) DC accelerator that produces a beam of 1.75 or 1.89 MeV protons. These protons impact a target with coatings of C-13 and S-34. Depending on the coating, the resultant resonant gamma rays are preferentially absorbed in either N-14 or CL-35. The resonant gammas come off the target in a conical fan at 80.7 deg for N and 82 deg for Cl; a common array of segmented BGO detectors is used over an arc of 53 deg to provide input to an imaging subsystem. The tomography makes use of rotation and vertical translation of a baggage carousel holding typically 18 average sized bags for batch processing of the contents. The single proton accelerator and target can supply multiple detection stations with the appropriate gammas, a feature that may lead to very high throughput potential approaching 2000 bags/hr. Each detection station can operate somewhat independently from the others. This paper presents the overall requirements, design, operating principles, and characteristics of the CDS proof-of-principle device developed in the Phase I program.
DOE

ARPA Computer Network; Imaging Techniques; Nitrogen Isotopes; Narcotics; Tomography; Gamma Rays; Drugs; Detection; Carbon 13

19970001686 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA USA
Conflict Probability Estimation for Free Flight
Paielli, Russell A., National Aeronautics and Space Administration. Ames Research Center, USA; Erzberger, Heinz, National Aeronautics and Space Administration. Ames Research Center, USA; Oct. 1996; 18p; In English
Contract(s)/Grant(s): RTOP 505-64-13
Report No.(s): NASA-TM-110411; NAS 1.15:110411; A-962310; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The safety and efficiency of free flight will benefit from automated conflict prediction and resolution advisories. Conflict prediction is based on trajectory prediction and is less certain the farther in advance the prediction, however. An estimate is therefore needed of the probability that a conflict will occur, given a pair of predicted trajectories and their levels of uncertainty. A method is developed in this paper to estimate that conflict probability. The trajectory prediction errors are modeled as normally distributed, and the two error covariances for an aircraft pair are combined into a single equivalent covariance of the relative position. A coordinate transformation is then used to derive an analytical solution. Numerical examples and Monte Carlo validation are presented.
Author

Free Flight; Air Traffic Control; Coordinate Transformations; Monte Carlo Method; Aircraft Safety; Covariance

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19970001587 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Velocity Determination for an Inverted Pseudolite Navigation Reference System
Hebert, Jeffrey M., Air Force Inst. of Tech., USA; Dec. 1995; 119p; In English
Report No.(s): AD-A305930; AFIT/GE/ENG/95D-06; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

As navigation systems continue to improve in performance and features, the Air Force must develop better Navigation Reference Systems (NRS) to keep pace with technology. Specifically, with the advent of enhanced, integrated Global Positioning System (GPS) and Inertial Navigation System (INS) navigators, emphasis is placed on the measuring performance in the presence of GPS jamming. To meet these needs, a new NRS, dubbed the Sub-Meter Accuracy Reference System (SARS), is being developed by the 746th Test Squadron, Holloman AFB, New Mexico. SARS uses a unique, inverted GPS pseudolite positioning system to determine a reference trajectory. This research investigates two pos processing methods of determining velocity from a discrete

position data at a constant data rate. The first method employs numerical differentiation along with digital filters provide noise reduction. The second method uses kinematic model based Kalman filter and smoothing to determine the reference velocity.
DTIC
Global Positioning System; Navigation; Velocity; Trajectory Optimization

19970001840 Netherlands Organization for Applied Scientific Research TNO, Physics and Electronics Lab., The Hague, Netherlands

The ORFEO Measurement Campaign

vanderHeiden, R., Netherlands Organization for Applied Scientific Research TNO, Netherlands; deVries, J., Netherlands Organization for Applied Scientific Research TNO, Netherlands; Aug. 1996; 39p; In English
Report No.(s): TNO-FEL-96-A073; Copyright; Avail: Issuing Activity (Netherlands Organization for Applied Scientific Research (TNO), The Hague, Netherlands), Hardcopy, Microfiche

At TNO-FEL, a target database of civil aircraft was gained using the FELSTAR S-Band radar. The measurement campaign, named 'range profile acquisition with the FELSTAR radar for NCTR research' (ORFEO), provided over 30,000 range profiles from 17 different civil aircraft of opportunity. The measurements will complement the currently available data base of military aircraft. This report documents the measurement campaign.
Derived from text
Data Acquisition; Radar Signatures; Target Recognition; Commercial Aircraft; Data Bases; High Resolution

19970003071 Clemson Univ., SC USA

Controlling Air Traffic (Simulated) in the Presence of Automation (CATS PAu) 1995: A Study of Measurement Techniques for Situation Awareness in Air Traffic Control

French, Jennifer R., Clemson Univ., USA; Technical Reports: Langley Aerospace Research Summer Scholars; 1995, Part 1, pp. 195-204; In English; Also announced as 19970003049; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

As automated systems proliferate in aviation systems, human operators are taking on less and less of an active role in the jobs they once performed, often reducing what should be important jobs to tasks barely more complex than monitoring machines. When operators are forced into these roles, they risk slipping into hazardous states of awareness, which can lead to reduced skills, lack of vigilance, and the inability to react quickly and competently when there is a machine failure. Using Air Traffic Control (ATC) as a model, the present study developed tools for conducting tests focusing on levels of automation as they relate to situation awareness. Subjects participated in a two-and-a-half hour experiment that consisted of a training period followed by a simulation of air traffic control similar to the system presently used by the FAA, then an additional simulation employing automated assistance. Through an iterative design process utilizing numerous revisions and three experimental sessions, several measures for situational awareness in a simulated Air Traffic Control System were developed and are prepared for use in future experiments.
Author
Automatic Control; Simulation; Intelligence Tests; Performance Tests; Training Evaluation

19970003097 Saint Cloud State Coll., MN USA

TAP/ASTA Flight Demo Data Analysis

Mejdrich, Eric, Saint Cloud State Coll., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 483-503; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recently the Low Visibility Landing and Surface Operations (LVLASO) project team of the Systems Integration Branch at the NASA Langley Research Center completed a flight demonstration of TAP/ASTA concepts at the Atlantic City airport. This paper is concerned with the analysis of the aircraft data that was recorded by the test vehicle during the duration of the flight demonstrations.
Author
Data Acquisition; Flight Tests; Low Visibility; Landing; Data Processing

19970003303 Naval Air Warfare Center, Patuxent River, MD USA

Robust Relative All-in-View KCPT Solution for Aircraft Carrier Landing Operations

Johnson, Greg, E-Systems, Inc., USA; Thornberg, Bryce, E-Systems, Inc., USA; Chesson, Phill, E-Systems, Inc., USA; Wellons, Lee, Naval Air Warfare Center, USA; Briggs, Tom, Naval Air Warfare Center, USA; Apr. 17, 1996; 5p; In English; Original contains color plates
Report No.(s): AD-A314060; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Providing precision guidance to an aircraft landing aboard a ship requires a robust and extremely accurate positioning system. Several carrier controlled approach aids (such as the AN/SPN-42A/46 Automatic Carrier Landing System) currently provide the required accuracy for the U.S. Navy. However, these systems experience reduced performance in precipitation and are difficult to maintain. A relative Global Positioning System (GPS) Kinematic Carrier Phase Tracking (KCPT) solution has the potential to provide a highly accurate solution for shipboard landing operations which is unaffected by weather.

DTIC

Aircraft Carriers; Aircraft Landing; Global Positioning System

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970001324 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Research Inst. of Pilotless Aircraft, Jiangsu, China

Fuselage Structural Optimization With MSC/MOD Pre-Processing and MSC/PAL2 Post-Processing

Chen, Mulan, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Liu, Xu, Ministry of Electronics Industry, China; Qiao, Xin, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Transactions of Nanjing University of Aeronautics and Astronautics; Dec. 1994; Volume 11, No. 2, pp. 147-153; In English; Also announced as 19970001320; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A thin walled structure with multiple load conditions and subjected to stress, displacement, and gauge constrains is studied using the finite element method for structural optimization design. The thickness of plates and cross sectional area of beams and bars are chosen as design variables. The Kuhn-Tucker necessary condition is used to obtain the minimum weight design. In order to speed up the iteration process of the multiple displacement constraint problem, we simplify it to a single most critical displacement constraint, which eliminates the need to calculate a large set of Lagrange multipliers for all the active constraints. An optimization criteria is derived. A recursive formula for stress and displacement constraints is derived and implemented in the design optimization algorithm named FOPT, which approaches the optimum design along the most active constraint boundary. Design variable linking techniques are used to reduce the number of independent design variables to several design groups. A program using finite element analysis for optimization of large scale structures was developed which runs on an IBM-3081 computer. The application of the program to a number of structures demonstrates the efficiency and accuracy of the method.

Author

Fuselages; Optimization; Finite Element Method; Structural Design; Computer Aided Design

19970001368 NASA Langley Research Center, Hampton, VA USA

Transonic Shock Oscillations and Wing Flutter Calculated with an Interactive Boundary Layer Coupling Method

Edwards, John W., NASA Langley Research Center, USA; Aug. 1996; 20p; In English; EUROMECH-Colloquium 349, 16-18 Sep. 1996, Gottingen, Germany

Contract(s)/Grant(s): RTOP 505-63-50-13

Report No.(s): NASA-TM-110284; NAS 1.15:110284; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A viscous-inviscid interactive coupling method is used for the computation of unsteady transonic flows involving separation and reattachment. A lag-entrainment integral boundary layer method is used with the transonic small disturbance potential equation in the CAP-TSDV code. Efficient and robust computations of steady and unsteady separated flows, including steady separation bubbles and self-excited shock-induced oscillations are presented. The buffet onset boundary for the NACA 0012 airfoil is accurately predicted and shown computationally to be a Hopf bifurcation. Shock-induced oscillations are also presented for the 18 percent circular arc airfoil. The oscillation onset boundaries and frequencies are accurately predicted, as is the experimentally observed hysteresis of the oscillations with Mach number. This latter stability boundary is identified as a jump phenomenon. Transonic wing flutter boundaries are also shown for a thin swept wing and for a typical business jet wing, illustrating viscous effects on flutter and the effect of separation onset on the wing response at flutter. Calculations for both wings show limit cycle oscillations at transonic speeds in the vicinity of minimum flutter speed indices.

Author

Transonic Flutter; Transonic Flow; Unsteady Flow; Separated Flow; Computational Fluid Dynamics; Flow Equations; Mach Number; Unsteady Aerodynamics

19970001375 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA USA
Parallelization of a Parabolized Navier-Stokes Solver with a Design Optimizer ***Final Report***
Pallis, J. M., California Univ., USA; Chattot, J. J., California Univ., USA; Lawrence, S. L., NASA Ames Research Center, USA; 1996; 7p; In English; 34th; Aerospace Sciences Meeting and Exhibit; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC2-5043
Report No.(s): NASA-CR-202423; NAS 1.26:202423; AIAA Paper 96-0549; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The design of future supersonic aircraft, such as the High Speed Civil Transport (HSCT), will rely heavily on computational methods for aircraft design and the prediction of the complex aerodynamics encountered in flight. Parabolized Navier-Stokes (PNS) equation flow solvers are recognized as efficient and accurate computational tools for the solution of supersonic and hypersonic flow-fields, while design optimizers have the potential to be valuable tools within the overall design process. Presently, however, the execution of the flow solver in conjunction with a design optimizer presents a computationally intensive and formidable problem. to meet the challenges and increasing demand for multidisciplinary numerical tools which are faster, more robust and provide greater functionality, alternative strategies are explored to increase computational throughput by coupling a design optimizer and flow solver in a parallel processing environment. to address this problem the parallel processing of a PNS flow solver with a nonlinear constraint design optimizer is investigated as an alternative computational method.
Author
Aerodynamics; Aircraft Design; Hypersonic Flow; Navier-Stokes Equation; Supersonic Aircraft; Supersonic Flow; Supersonic Transports

19970001423 NASA Dryden Flight Research Center, Edwards, CA USA
Design and Integration of an Actuated Nose Strake Control System
Flick, Bradley C., NASA Dryden Flight Research Center, USA; Thomson, Michael P., NASA Dryden Flight Research Center, USA; Regenie, Victoria A., NASA Dryden Flight Research Center, USA; Wichman, Keith D., NASA Dryden Flight Research Center, USA; Pahle, Joseph W., NASA Dryden Flight Research Center, USA; Earls, Michael R., NASA Dryden Flight Research Center, USA; Oct. 1996; 32p; In English; 5th; High Angle of Attack Technology Conference, 17-19 Sep., Hampton, VA, USA
Contract(s)/Grant(s): RTOP 505-68-30
Report No.(s): NASA-TM-104324; H-2134; NAS 1.15:104324; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aircraft flight characteristics at high angles of attack can be improved by controlling vortices shed from the nose. These characteristics have been investigated with the integration of the actuated nose strakes for enhanced rolling (ANSER) control system into the NASA F-18 High Alpha Research Vehicle. Several hardware and software systems were developed to enable performance of the research goals. A strake interface box was developed to perform actuator control and failure detection outside the flight control computer. A three-mode ANSER control law was developed and installed in the Research Flight Control System. The thrust-vectoring mode does not command the strakes. The strakes and thrust-vectoring mode uses a combination of thrust vectoring and strakes for lateral- directional control, and strake mode uses strakes only for lateral-directional control. The system was integrated and tested in the Dryden Flight Research Center (DFRC) simulation for testing before installation in the aircraft. Performance of the ANSER system was monitored in real time during the 89-flight ANSER flight test program in the DFRC Mission Control Center. One discrepancy resulted in a set of research data not being obtained. The experiment was otherwise considered a success with the majority of the research objectives being met.
Author
F-18 Aircraft; Airborne/Spaceborne Computers; Control Theory; Directional Control; Attitude Control; Flight Control; Flight Tests; Lateral Control; Thrust Vector Control; Strakes

19970001461 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Wake Geometry Measurements and Analytical Calculations on a Small-Scale Rotor Model
Ghee, Terence A., Analytical Services and Materials, Inc., USA; Berry, John D., Army Aviation Systems Command, USA; Zori, Laith A. J., Iowa State Univ. of Science and Technology, USA; Elliott, Joe W., Army Aviation Systems Command, USA; Aug. 1996; 68p; In English
Contract(s)/Grant(s): RTOP 505-59-39-01; DA Proj. 1L1-62211-A-47-A
Report No.(s): NASA-TP-3584; L-17449; NAS 1.60:3584; ATCOM-TR-96-A-007; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An experimental investigation was conducted in the Langley 14- by 22-Foot Subsonic Tunnel to quantify the rotor wake behind a scale model helicopter rotor in forward level flight at one thrust level. The rotor system in this test consisted of a four-bladed

fully articulated hub with blades of rectangular planform and an NACA 0012 airfoil section. A laser light sheet, seeded with propylene glycol smoke, was used to visualize the vortex geometry in the flow in planes parallel and perpendicular to the free-stream flow. Quantitative measurements of wake geometric proper- ties, such as vortex location, vertical skew angle, and vortex particle void radius, were obtained as well as convective velocities for blade tip vortices. Comparisons were made between experimental data and four computational method predictions of experimental tip vortex locations, vortex vertical skew angles, and wake geometries. The results of these comparisons highlight difficulties of accurate wake geometry predictions.
Author
Wakes; Vortices; Rotors; Rotary Wings; Horizontal Flight; Scientific Visualization; Airfoil Profiles; Blade Tips; Helicopters; Light Beams; Laser Outputs

19970001676 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
A Comparison of Pressure Measurements Between a Full-Scale and a 1/6-Scale F/A-18 Twin Tail During Buffet
Moses, Robert W., National Aeronautics and Space Administration. Langley Research Center, USA; Pendleton, Ed, Wright Lab., USA; Aug. 1996; 16p; In English
Contract(s)/Grant(s): RTOP 505-63-50-13
Report No.(s): NASA-TM-110282; NAS 1.15:110282; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 1993, tail buffet tests were performed on a full-scale, production model F/A-18 in the 80 x 120-foot Wind Tunnel at NASA Ames Research Center. Steady and unsteady pressures were recorded on both sides of the starboard vertical tail for an angle-of-attack range of 20 to 40 degrees and at a sideslip range of -1 6 to 16 degrees at freestream velocities up to 100 knots (Mach 0.15, Reynolds number 1.23 x 10(exp 7). The aircraft was equipped with removable leading edge extension (LEX) fences that are used in flight to reduce tail buffet loads. In 1995, tail buffet tests were performed on a 1/6-scale F-18 A/B model in the Transonic Dynamics Tunnel (TDT) at NASA Langley Research Center. Steady and unsteady pressures were recorded on both sides of both vertical tails for an angle-of-attack range of 7 to 37 degrees at freestream velocities up to 65 knots (Mach 0.10). Comparisons of steady and unsteady pressures and root bending moments are presented for these wind-tunnel models for selected test cases. Representative pressure and root bending moment power spectra are also discussed, as are selected pressure cross-spectral densities.
Author
Pressure Measurement; Angle of Attack; Wind Tunnel Tests; Bending Moments; Pressure Distribution; Tail Assemblies; Buffeting; Full Scale Tests

19970001702 Daimler-Benz Aerospace A.G., Military Aircraft, Munich, Germany
Fundamentals on Damage Monitoring
Boller, Christian, Daimler-Benz Aerospace A.G., Germany; Oct. 1996; 16p; In English; Also announced as 19970001697; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Within the paper, the following is discussed: existing load monitoring systems in aircraft and their use for fatigue damage evaluation; validation of different NDT-techniques with regard to their use for and integration into composite materials; validation of the use of structural health (damage) monitoring systems; parameters and techniques based on piezoelectric sensing for monitoring impact loads. It is concluded that structural health monitoring can have a beneficial effect in combination with composite materials.
Author
Damage Assessment; Detection; Fatigue (Materials); Aircraft Structures; Impact Loads

19970001707 Northrop Grumman Corp., Military Aircraft Systems Div., El Segundo, CA USA
Structural Health Monitoring of Aircraft Components
Kudva, Jayanth N., Northrop Grumman Corp., USA; Lockyer, Allen J., Northrop Grumman Corp., USA; VanWay, Craig B., Northrop Grumman Corp., USA; Oct. 1996; 6p; In English; Also announced as 19970001697
Contract(s)/Grant(s): F33615-92-C-3203; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Since the late fifties when fatigue problems in aircraft structures were first encountered, aircraft maintenance has evolved through research, and subsequent implementation in well-orchestrated programs in several NATO countries. In the USA Air Force, the Aircraft Structural Integrity Program (ASIP), and similar programs in other US service organizations, deserve much of the credit for establishing a first class record for US fleet readiness. ASIP’s success, similar to other NATO programs, rely heavily (still) on frequent aircraft inspections to ensure fatigue cracking, or other flaws, get the necessary attention, and appropriate corrective action, before vehicle safety is compromised. Recent initiatives at Northrop Grumman, together with research elsewhere in structural health monitoring systems (SHMS), now point one step further toward improved safety and maintenance costs reductions. Though not yet mature, recent technological advances in sensors, data acquisition, electronic miniaturization, and sen-

sor system integration, now make it conceivable, at least, to replace current scheduled driven inspection practices - prevalent in aerospace systems maintenance throughout NATO- with 'maintenance-on-demand.' Put simply, aircraft structural inspections and maintenance will be performed only when really necessary and there is a high probability of finding damage, rather than scheduled, when often there is no damage detected. An overview of ASIP is first introduced as background to the subject of structural health monitoring in the US reviewing inspection requirements, critical flaw sizes, and operational load environments. SHMS technologies are subsequently reviewed featuring requirements, architectures and components, sensors, processors, analysis algorithms and software, and SHMS component technology status. Finally, conclusions and recommendations for technology transition and future work are reported.
Author
Aircraft Structures; Aircraft Maintenance; Aerospace Systems; Defects; Health

19970001708 Northrop Grumman Corp., Military Aircraft Systems Div., El Segundo, CA USA
Adaptive Aircraft Wing
Kudva, Jayanth N., Northrop Grumman Corp., USA; Lockyer, Allen J., Northrop Grumman Corp., USA; Appa, Kari, Northrop Grumman Corp., USA; Oct. 1996; 6p; In English; Also announced as 19970001697; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The concept of an adaptive aircraft wing, i.e., whose shape parameters such as camber, span-wise twist, and thickness can be varied to optimize the wing shape for various flight conditions, has been extensively studied by numerous researchers. While the aerodynamic benefits (in terms of increased lift/drag ratios, improved maneuverability, and delayed flow separation) have been analytically and experimentally established, the complexity and weight penalty of the designs and actuation mechanisms have limited their practical implementation. Recent developments in sensors and actuators using smart materials could potentially alleviate the shortcomings of prior designs, leading the way to a more practical 'smart' adaptive wing which responds to changes in flight and environmental conditions by optimally modifying its shape. A summary of recent work in the area of adaptive wing concepts incorporating smart structures technologies i s presented. Emphasis is placed on continuing research at Northrop Grumman under a USA Defense Advanced Research Projects Agency (DARPA) contract entitled 'Smart Structures and Materials Development-Smart Wing.' Limitations and potential benefits of adaptive wing designs, applications and advantages of smart material actuators and sensors, and results of recent tests are discussed. Recommendations for future work required to develop an operational smart adaptive wing are also outlined.
Author
Smart Structures; Camber; Lift Drag Ratio; Maneuverability; Cambered Wings

19970001796 Stanford Univ., Dept. of Aeronautics and Astronautics, CA USA
Computation of Lifting Wing-Flap Configurations ***Final Report, 1 Jul. 1994 - 30 Jun. 1995***
Cantwell, Brian, Stanford Univ., USA; Kwak, Dochan, National Aeronautics and Space Administration. Ames Research Center, USA; Oct. 1996; 13p; In English
Contract(s)/Grant(s): NCC2-5070
Report No.(s): NASA-CR-202507; NAS 1.26:202507; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Research has been carried out on the computation of lifting wing-flap configurations. The long term goal of the research is to develop improved computational tools for the analysis and design of high lift systems. Results show that state-of-the-art computational methods are sufficient to predict time-averaged lift and overall flow field characteristics on simple high-lift configurations. Recently there has been an increased interest in the problem of airframe generated noise and experiments carried out in the 7 x 10 wind tunnel at NASA Ames have identified the flap edge as an important source of noise. A follow-on set of experiments will be conducted toward the end of 1995. The computations being carried out under this project are coordinated with these experiments. In particular, the model geometry being used in the computations is the same as that in the experiments. The geometry consists of a NACA 63-215 Mod B airfoil section which spans the 7 x lO tunnel. The wing is unswept and has an aspect ratio of two. A 30% chord Fowler flap is deployed modifications of the flap edge geometry have been shown to be effective in reducing noise and the existing code is currently being used to compute the effect of a modified geometry on the edge flow.
Author
Aerodynamic Configurations; Flow Distribution; Lift; Wing Flaps; Computational Grids; Turbulence Models; Pressure Distribution; Computational Fluid Dynamics

19970001800 Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA
A New Higher-Order Composite Theory for Analysis and Design of High Speed Tilt-Rotor Blades
McCarthy, Thomas Robert, Arizona State Univ., USA; Oct. 1996; 182p; In English

Contract(s)/Grant(s): NAG2-771

Report No.(s): NASA-CR-196703; A-962808; NAS 1.26:196703; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

A higher-order theory is developed to model composite box beams with arbitrary wall thicknesses. The theory, based on a refined displacement field, represents a three-dimensional model which approximates the elasticity solution. Therefore, the cross-sectional properties are not reduced to one-dimensional beam parameters. Both inplane and out-of-plane warping are automatically included in the formulation. The model accurately captures the transverse shear stresses through the thickness of each wall while satisfying all stress-free boundary conditions. Several numerical results are presented to validate the present theory. The developed theory is then used to model the load carrying member of a tilt-rotor blade which has thick-walled sections. The composite structural analysis is coupled with an aerodynamic analysis to compute the aeroelastic stability of the blade. Finally, a multidisciplinary optimization procedure is developed to improve the aerodynamic, structural and aeroelastic performance of the tilt-rotor aircraft. The Kreisselmeier-Steinhauser function is used to formulate the multiobjective function problem and a hybrid approximate analysis is used to reduce the computational effort. The optimum results are compared with the baseline values and show significant improvements in the overall performance of the tilt-rotor blade.

Author

Tilt Rotor Aircraft; Three Dimensional Models; Multidisciplinary Design Optimization; Rotary Wings; Composite Structures; Mathematical Models; Aerodynamic Loads; Aeroelasticity

19970001894 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA

Aeroelastic Calculations Using CFD for a Typical Business Jet Model

Gibbons, Michael D., Lockheed Engineering and Sciences Co., USA; Sep. 1996; 46p; In English

Contract(s)/Grant(s): NAS1-19000; RTOP 505-63-50-13

Report No.(s): NASA-CR-4753; NAS 1.26:4753; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two time-accurate Computational Fluid Dynamics (CFD) codes were used to compute several flutter points for a typical business jet model. The model consisted of a rigid fuselage with a flexible semispan wing and was tested in the Transonic Dynamics Tunnel at NASA Langley Research Center where experimental flutter data were obtained from M(sub infinity) = 0.628 to M(sub infinity) = 0.888. The computational results were computed using CFD codes based on the inviscid TSD equation (CAP-TSD) and the Euler/Navier-Stokes equations (CFL3D-AE). Comparisons are made between analytical results and with experiment where appropriate. The results presented here show that the Navier-Stokes method is required near the transonic dip due to the strong viscous effects while the TSD and Euler methods used here provide good results at the lower Mach numbers.

Author

Computational Fluid Dynamics; Aeroelasticity; Flexible Wings; Flutter; Inviscid Flow; Navier-Stokes Equation; Viscous Flow; Aerodynamic Coefficients

19970002885 Instytut Lotnictwa, Warsaw, Poland

Simulation of Airplane Passing Through a Region of Atmospheric Disturbances Using Low Order Panel Methods ***Symulacja przelotu samolotu przez obszar zaburzen z zastosowaniem metod panelowych niskiego rzedu***

Kulicki, Piotr, Instytut Lotnictwa, Poland; Transactions of the Institute of Aviation Scientific Quarterly; 1996; Volume 45, pp. 64-71; In Polish; Also announced as 19970002881; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The simulation of the motion of an aircraft passing through an atmospheric disturbance is studied using simple potential flow models. The atmospheric disturbance is assumed to be a velocity field nonuniform in space or time. The disturbance is modeled as a system of three dimensional vortex rings. A mirror reflection of the system is introduced to simulate the ground surface. Only a longitudinal motion of the aircraft is considered (symmetrical gliding). Three different aerodynamic models are taken into account: a linear model based on classical aerodynamic derivatives, a lifting line model, and the vortex lattice method (VLF). The disturbance model, the aircraft motion model, and the aerodynamic model are coupled into a simulation model. Calculations were conducted for two tapered, swept wings. Fuselage effects were not accounted for. A higher sensitivity to disturbances is observed for the VLM than for either the classical linear model or the lifting line model. The application of VLM for aerodynamic calculations of aircraft motion simulation allows for some effect which are impossible to account for in either of the other two models. However, simple VLM does not approximate accurately load distribution along a chord. The choice of model should be verified with experimental data.

Derived from text

Motion Simulation; Vortex Lattice Method; Vortex Rings; Potential Flow; Panel Method (Fluid Dynamics); Flight Simulation

19970002886 Instytut Lotnictwa, Warsaw, Poland

Determination of Sailplane Loading Caused by Thermal Gust by Means of Panel Methods ***Wyznaczanie obcianzen szybow-***

ca w podmuchu termicznym z wykorzystaniem metod panelowych

Lasek, Maciej, Instytut Lotnictwa, Poland; Transactions of the Institute of Aviation Scientific Quarterly; 1996; Volume 45, pp. 72-82; In Polish; Also announced as 19970002881; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A mathematical model of aircraft reaction to flow disturbances such as thermal gusts, wind shear, and turbulence is discussed in terms of the motion of a sailplane in the presence of external flow disturbances. It is assumed that the sailplane is a rigid body and that it is possible to calculate the velocity distribution on the surface and the region around the sailplane using the potential flow equations solution. The external flow disturbance is modeled as an arbitrary set velocity field variable in space. The dynamic equations of sailplane motion are derived from generalized equations of momentum and angular momentum changes of the rigid body in relation to its center of mass as expressed in the sailplane body axes system. In order to calculate the aerodynamic forces and moments acting on the sailplane, a flow model is derived based on the Laplace equation for disturbance potential under the assumption of inviscid, incompressible, attatched and/or irrotational flow.

Derived from text

Angular Momentum; Rigid Structures; Velocity Distribution; Gliders; Equations of Motion; Laplace Equation; Center of Mass; Aerodynamic Loads; Panel Method (Fluid Dynamics)

19970002887 Instytut Lotnictwa, Warsaw, Poland

Numerical Simulation of Spatial Motion Dynamics for Helicopter with Autopilot ***Numeryczna symulacja dynamiki przestrzennego ruchu smigglowca z autopilotem***

Kowaleczko, Grzegorz, Instytut Lotnictwa, Poland; Transactions of the Institute of Aviation Scientific Quarterly; 1996; Volume 45, pp. 83-96; In Polish; Also announced as 19970002881; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The principal assumptions of a physical and mathematical model of a helicopter autopilot system are presented. Control laws based on the method of separation of motions have been formulated. Results of the numerical simulation of the helicopter dynamics for one selected flight condition are presented. All couplings between longitudinal and lateral motions have been included.

Author

Automatic Pilots; Control Theory; Mathematical Models; Helicopters

19970003009 NASA Dryden Flight Research Center, Edwards,CA USA

An Overview of the NASA F-18 High Alpha Research Vehicle

Bowers, Albion H., NASA Dryden Flight Research Center, USA; Pahle, Joseph W., NASA Dryden Flight Research Center, USA; Wilson, R. Joseph, NASA Dryden Flight Research Center, USA; Flick, Bradley C., NASA Dryden Flight Research Center, USA; Rood, Richard L., NASA Dryden Flight Research Center, USA; Oct. 1996; 42p; In English; High-Angle-of-Attack Technology, 17-19 Sep. 1996, Hampton, VA, USA

Contract(s)/Grant(s): RTOP 505-68-30

Report No.(s): NASA-TM-4772; NAS 1.15:4772; H-2137; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper gives an overview of the NASA F-18 High Alpha Research Vehicle. The three flight phases of the program are introduced, along with the specific goals and data examples taken during each phase. The aircraft configuration and systems needed to perform the disciplinary and inter-disciplinary research are discussed. The specific disciplines involved with the flight research are introduced, including aerodynamics, controls, propulsion, systems, and structures. Decisions that were made early in the planning of the aircraft project and the results of those decisions are briefly discussed. Each of the three flight phases corresponds to a particular aircraft configuration, and the research dictated the configuration to be flown. The first phase gathered data with the baseline F-18 configuration. The second phase was the thrust-vectoring phase. The third phase used a modified forebody with deployable nose strakes. Aircraft systems supporting these flights included extensive instrumentation systems, integrated research flight controls using flight control hardware and corresponding software, analog interface boxes to control forebody strakes, a thrust-vectoring system using external post-exit vanes around axisymmetric nozzles, a forebody vortex control system with strakes, and backup systems using battery-powered emergency systems and a spin recovery parachute.

Author

F-18 Aircraft; Angle of Attack; Thrust Vector Control; Forebodies; Propulsion System Configurations; Propulsion System Performance

19970003010 NASA Ames Research Center, Moffett Field,CA USA

Wing Leading Edge Joint Laminar Flow Tests

Drake, Aaron, Washington Univ., USA; Westphal, Russell V., Washington Univ., USA; Zuniga, Fanny A., NASA Ames Research Center, USA; Kennelly, Robert A., Jr., NASA Ames Research Center, USA; Koga, Dennis J., NASA Ames Research Center, USA; Oct. 1996; 38p; In English

Contract(s)/Grant(s): RTOP 505-59-20
Report No.(s): NASA-TM-4762; NAS 1.15:4762; A-962704; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An F-104G aircraft at NASA's Dryden Flight Research Center has been equipped with a specially designed and instrumented test fixture to simulate surface imperfections of the type likely to be present near the leading edge on the wings of some laminar flow aircraft. The simulated imperfections consisted of five combinations of spanwise steps and gaps of various sizes. The unswept fixture yielded a pressure distribution similar to that of some laminar flow airfoils. The experiment was conducted at cruise conditions typical for business-jets and light transports: Mach numbers were in the range 0.5-0.8, and unit Reynolds numbers were 1.5-2.5 million per foot. Skin friction measurements indicated that laminar flow was often maintained for some distance downstream of the surface imperfections. Further work is needed to more precisely define transition location and to extend the experiments to swept-wing conditions and a broader range of imperfection geometries.

Author

F-104 Aircraft; Research Aircraft; Laminar Flow Airfoils; Friction Measurement; Mach Number; Reynolds Number; Skin Friction; Swept Wings

19970003066 Kansas Univ., Lawrence, KS USA

The Development and Use of a Flight Optimization System Model of a C-130E Transport Aircraft

Desch, Jeremy D., Kansas Univ., USA; Technical Reports: Langley Aerospace Research Summer Scholars; 1995; Part 1, pp. 145-154; In English; Also announced as 19970003049; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The Systems Analysis Branch at NASA Langley Research Center conducts a variety of aircraft design and analyses studies. These studies include the prediction of characteristics of a particular conceptual design, analyses of designs that already exist, and assessments of the impact of technology on current and future aircraft. The FLight OPtimization System (FLOPS) is a tool used for aircraft systems analysis and design. A baseline input model of a Lockheed C-130E was generated for the Flight Optimization System. This FLOPS model can be used to conduct design-trade studies and technology impact assessments. The input model was generated using standard input data such as basic geometries and mission specifications. All of the other data needed to determine the airplane performance is computed internally by FLOPS. The model was then calibrated to reproduce the actual airplane performance from flight test data. This allows a systems analyzer to change a specific item of geometry or mission definition in the FLOPS input file and evaluate the resulting change in performance from the output file. The baseline model of the C-130E was used to analyze the effects of implementing upper wing surface blowing on the airplane. This involved removing the turboprop engines that were on the C-130E and replacing them with turbofan engines. An investigation of the improvements in airplane performance with the new engines could be conducted within the Flight Optimization System. Although a thorough analysis was not completed, the impact of this change on basic mission performance was investigated.

Author (revised)

Manufacturing; Flight Optimization; Design Analysis; C-130 Aircraft; Aircraft Design

19970003090 Pembroke State Univ., NC USA

Effects of Nose Strakes On Transport Aircraft

Locklear, Calvin T., Pembroke State Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 421-424; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A low-speed wind tunnel investigation was conducted in the Langley 12-Foot Tunnel on a typical commercial transport configuration to determine the effect of adding nose strakes on the aerodynamic characteristics of the model. The fuselage and wings of the model were scaled versions of the McDonnell-Douglas DC-9 aircraft. A generic tail assembly was employed that was different from that of the DC-9. Three different strake configurations were tested at several inclination angles. One strake configuration was identical to that employed on the DC-9 aircraft. The model was tested through a range of angles of attack and sideslip angles. Tests were made both with and without strakes and also with the vertical tail removed.

Author

Wind Tunnel Tests; Low Speed; Aerodynamic Characteristics; Tail Assemblies; Aerodynamic Configurations

19970003092 Embry-Riddle Aeronautical Univ., Dept. of Aerospace Engineering, Daytona Beach, FL USA

Design Considerations for the Next Generation of General Aviation Designs

Marchesseault, Brian D., Embry-Riddle Aeronautical Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 431-441; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper discusses the results of research conducted at NASA Langley Research Center during two summer programs during 1994 and 1995. These programs were the NASA Advanced Design Program and the Langley Research Summer Scholars program. The work was incorporated in a three phase project at Embry-Riddle Aeronautical University which focused on

development of the next generation Primary Flight Trainer, as well as in ERAU's participation in the AGATE General Aviation Design Competition. The project was conducted as part of the ERAU/NASA/USRA Advanced Design Program in Aeronautics as well as the AGATE competition. A design study was completed which encompassed the incorporation of existing conventional technologies and advanced technologies into PFT designs and advanced GA aircraft designs. Multiple aircraft configurations were also examined throughout the ADP/AGATE. Evaluations of the various technologies and configurations studied will be made and recommendations will be included.
Author
Design Analysis; Aircraft Design; Aircraft Configurations; Training Devices

19970003131 Kansas Univ., Lawrence, KS USA
Very Light Aircraft: Revitalization through Certification
Zyskowski, Michael K., Kansas Univ., USA; Langley Aerospace Research Summer Scholars; 1995; Part 2, pp. 845-854; In English; Also announced as 19970003089; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

As the future of the general aviation industry seems to be improving, a cultural paradigm shift may be imminent with the implementation of an advanced, revolutionary transportation system within the USA. by observing the support of government and industry for this idea, near and long term effects must be addressed if this change is going to occur. The high certification costs associated with general aviation aircraft must be reduced without compromising safety if a new transportation system is to be developed in the future. With the advent of new, streamlined rules recently issued for the certification of small aircraft, it seems as though new opportunities are now available to the general aviation industry. Not only will immediate benefits be realized with increased sales of certified small aircraft, but there would now be a way of introducing the advanced concepts of future aircraft at varying degrees of technology and cost as options to the customer.
Author
Aircraft Industry; General Aviation Aircraft; Light Aircraft; Air Transportation

19970003302 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Simulation Support of a 17.5 Percent Scale F/A-18E/F Remotely Piloted Vehicle
Fitzgerald, Timothy R., Naval Air Warfare Center, USA; Gingras, David R., Science Applications International Corp., USA; May 30, 1996; 7p; In English
Report No.(s): AD-A314057; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

As defense budgets continue to shrink, cost-effective methods for the accurate and timely acquisition of aerodynamic data must be developed. Traditionally, wind tunnels have fulfilled this role at both the conceptual and developmental stages, as well as throughout the service life of an aircraft. However, although wind tunnels are a trusted and valuable data source that provide consistent repeatable data upon which to construct aerodynamic models, they also have inherent limitations such as blockage effects, wll and sting interference, and flow variations. Because of these constraints and due to the elevated angles-of-attack and sideslip that modern fighter aircraft are capable of, wind tunnels can be limited in their ability to cover an entire flight envelope.
DTIC
Data Acquisition; Cost Effectiveness; Aerodynamic Characteristics; Angle of Attack; Fighter Aircraft; Wind Tunnels

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970001689 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA
Microelectromechanical Systems for Aerodynamics Applications
Mehregany, Mehran, Case Western Reserve Univ., USA; DeAnna, Russell G., Army Research Lab., USA; Reshotko, Eli, Case Western Reserve Univ., USA; Sep. 1996; 14p; In English; 34th; Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 505-62-ON; DA Proj. 1L1-61102-AH-45
Report No.(s): NASA-TM-107320; NAS 1.15:107320; ARL-TR-1113; E-10417; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Microelectromechanical systems (MEMS) embody the integration of sensors, actuators, and electronics on a single substrate using integrated circuit fabrication techniques and compatible micromachining processes. Silicon and its derivatives form the material base for the MEMS technology. MEMS devices, including micro-sensors and micro-actuators, are attractive because they

can be made small (characteristic dimension about microns), be produced in large numbers with uniform performance, include electronics for high performance and sophisticated functionality, and be inexpensive. MEMS pressure sensors, wall-shear-stress sensors, and micromachined hot-wires are nearing application in aeronautics. MEMS actuators face a tougher challenge since they have to be scaled (up) to the physical phenomena that are being controlled. MEMS actuators are proposed, for example, for controlling the small structures in a turbulent boundary layer, for aircraft control, for cooling, and for mixing enhancement. Data acquisition or control logistics require integration of electronics along with the transducer elements with appropriate consideration of analog-to-digital conversion, multiplexing, and telemetry. Altogether, MEMS technology offers exciting opportunities for aerodynamics applications both in wind tunnels and in flight
Author
Micromachining; Microminiaturized Electronic Devices; Integrated Circuits; Systems Integration; Multiplexing; Low Cost; Technology Utilization; Actuators

19970002936 Defence Science and Technology Organisation, Air Operations Div., Melbourne, Australia
A Versatile Airborne Data Acquisition and Replay (VADAR) System
Holland, Owen F., Defence Science and Technology Organisation, Australia; Harvey, John F., Defence Science and Technology Organisation, Australia; Sutton, Colin W., Defence Science and Technology Organisation, Australia; Aug. 1996; 44p; In English
Report No.(s): DSTO-TR-0368; AR-009-751; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victioria 3001, Australia), Hardcopy, Microfiche

An airborne data acquisition system for recording flight information from helicopters operating at sea from ships is developed. This system is based on a portable personal computer. The design concepts, hardware configuration, control program, motion platform, and application transducers are described.
CASI
Data Acquisition; Helicopters; Flight Control; Attitude Control; Computer Programs; Real Time Operation; Airborne/Spaceborne Computers; Data Recording

19970003338 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Aircraft Application of MIL-STD-1553
Gallimore, Ian, Naval Air Warfare Center, USA; May 31, 1996; 6p; In English
Report No.(s): AD-A314058; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The MIL-STD-1553 interface provides a reliable, high speed data interchange protocol for electronic systems. A central processor, or mission computer, uses multiple independent 1553 channels, in this case two channels, each of which is dual redundant. Typical functions of the MC are: (1) acting as the bus controller (BC) for all 1553 channels; (2) integrating data from the various sensors to calculate navigation and fire control solutions; and (3) generating display information for the pilot.
DTIC
Bus Conductors; Architecture (Computers); Aircraft Equipment; Protocol (Computers); Avionics

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19970001328 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Dept. of Power Engineering, Jiangsu, China
A New Method to Judge the Enhancement of Heat Transfer in the Trailing Edge of Turbine Blades
Wang, Baoguan, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Transactions of Nanjing University of Aeronautics and Astronautics; Dec. 1994; Volume 11, No. 2, pp. 170-176; In English; Also announced as 19970001320; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An investigation of heat transfer and friction loss with taper pin fin configurations was conducted. Three kinds of configurations - full cross pin fins (FCF), shorter round pin fins (SRF), and taper pin fins (TPF), with different height and spacing of the fins and friction loss were compared with each other. In addition, a new dimensionless number, the ratio of f to Nu, called here the specific friction loss, is put forward to judge the validity of the configurations.
Author
Trailing Edges; Turbine Blades; Heat Transfer; Cooling Fins; Friction Factor; Air Cooling